

Claims

1. A surface treated steel material comprising a steel material and a chemical conversion film formed on at least a portion of the surface of the steel material, the chemical conversion film containing potassium in an amount of $0.1 - 1000 \text{ mg/m}^2$ and having a thickness of 5 – 50 micrometers.

2. A surface treated steel material as claimed in claim 1 wherein the chemical conversion film is a phosphate-type chemical conversion film.

3. A surface treated steel material as claimed in claim 2 wherein the chemical conversion film is a zinc phosphate-type or a manganese phosphate-type chemical conversion film.

4. A surface treated steel material as claimed in any one of claims 1 – 3 wherein the steel material has a steel composition containing 0.5 – 13 mass % of Cr.

5. A surface treated steel material as claimed in claim 4 wherein the steel material is a seamless steel pipe, and the chemical conversion film is provided on a threaded joint portion of the pipe.

6. A surface treated steel material as claimed in claim 5 wherein the steel pipe comprises an oil well pipe having a threaded portion.

7. A surface treated steel material as claimed in claim 5 wherein the steel pipe comprises a threaded coupling for an oil well pipe.

8. A method of manufacturing a surface treated steel material comprising performing chemical conversion treatment on a steel material using a chemical conversion treatment liquid containing zinc and phosphoric acid or manganese and phosphoric acid and further containing potassium.

9. A method of manufacturing a surface treated steel material as claimed in claim 8 wherein the chemical conversion treatment liquid has a molar concentration of potassium-containing ions of at least $6 \times 10^{-4} \%$ and at most $7 \times 10^{-1} \%$.

10. A method of manufacturing a surface treated steel material as claimed in claim 8 wherein chemical conversion treatment is carried out by immersing the surface of the steel material in the chemical conversion treatment liquid at a temperature of $60 - 100^{\circ}\text{C}$ for at least five minutes.

11. A method of manufacturing a surface treated steel material as claimed in claim 8 wherein the chemical conversion treatment is carried out by supplying the chemical conversion treatment to the surface of the steel material at a temperature of $60 - 100^{\circ}\text{C}$ for at least five minutes.

12. A method of manufacturing a surface treated steel material as claimed in any one of claims 8 - 11 wherein the chemical conversion treatment is carried out in the absence of fluoride ions.

13. A chemical conversion treatment liquid for a steel material containing zinc and phosphoric acid or manganese and phosphoric acid and further containing potassium.

14. A chemical conversion treatment liquid for a steel material as claimed in claim 13 which has a molar concentration of potassium-containing ions of at least $6 \times 10^{-4} \%$ and at most $7 \times 10^{-1} \%$.

15. A chemical conversion treatment liquid for a steel material as claimed in claim 13 or 14 wherein it contains manganese and phosphoric acid and further contains potassium, and wherein the total acid number is at least 30 and less than 55 and the ratio of the total acid number to the free acid number is $3 - 15$.